series in rows, 1 in the first row, and each row after the first containing k more terms than the preceding. Then the sum of the terms in any row is the cube of the number of terms in that row.

From the way in which the series is formed, the value of n for any term will be the same as the number of terms preceding it in the series. The number of terms in the rows will form an arithmetic series with first term 1 and difference k. Making use of these facts, we obtain the following:

The number of terms in the rth row is $1 + (r - 1)k$.

The value of n for the first term in the rth row is the sum of $r - 1$ terms of the arithmetic series with first term 1 and difference k, that is,

$$\frac{r-1}{2}[2 + (r - 2)k].$$

Making use of this value of n, we have for the first term in the rth row the value $1 + k(r - 1)[2 + (r - 2)k]$. The sum of the terms in the rth row will be the sum of $1 + (r - 1)k$ terms of the arithmetic series with first term $1 + k(r - 1)[2 + (r - 2)k]$ and difference $2k$, that is,

$$\frac{1 + (r-1)k}{2}\{2[1 + k(r - 1)\{2 + (r - 2)k\}] + k(r - 1)2k\} = \{1 + (r - 1)k\}^3.$$

This proves the theorem.

The two arrangements of the problem can be obtained by making $k = 2$ and $k = 1$, respectively.

Also solved by R. M. Mathews, Elijah Swift, Harmon L. Slobin, and S. A. Joffe.

QUESTIONS AND DISCUSSIONS.

Edited by U. G. Mitchell, University of Kansas.

At the time of making up copy for this issue further replies are desired to questions numbered 4, 8, 12, 13, 16, 20, 23, 24, 25 and 26.

NEW QUESTIONS.

27. A certain college wishes to offer twelve hours of mathematics beyond the usual courses in analytical geometry and differential and integral calculus. Considering only the needs of students intending to specialize in pure mathematics, what courses should make up the twelve hours offered?

28. Is it possible to obtain $\int \cos \theta^2 d\theta$ without expanding $\int \cos \theta^2$? If it is not, can some interesting properties of this integral be determined by treating it as a special function?

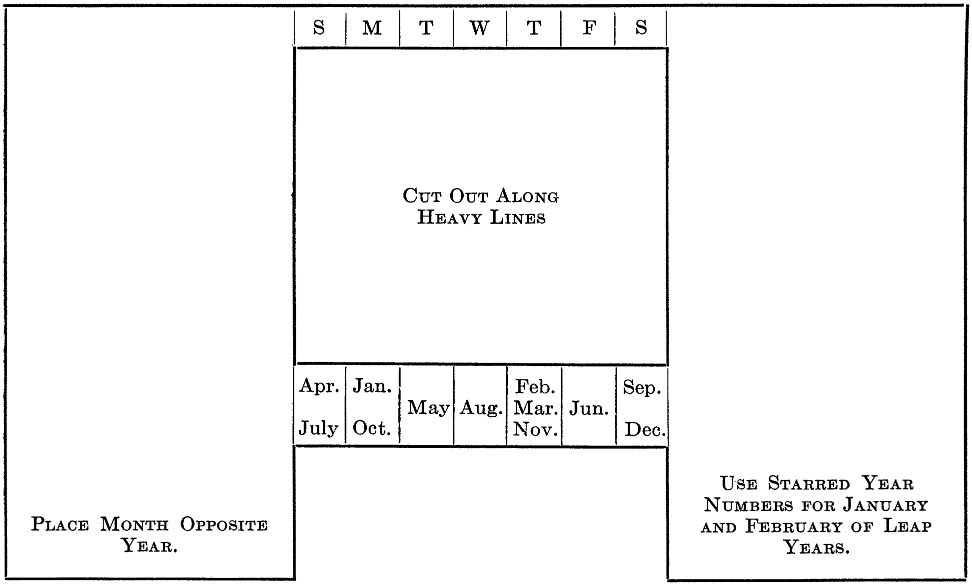
DISCUSSIONS.

RELATING TO ADJUSTABLE CALENDARS.

By Irwin Roman, Chicago, Ill.

So far as the writer has been able to learn, all perpetual or adjustable calendars are arranged so as to present the first day of the month as the first day of the week.

This arrangement makes it necessary to look at the top of the calendar to see what day of the week a certain date is. The accompanying drawings illustrate a calendar which presents Sunday first as in the ordinary printed sheet calendar.



						1	2	3	4	5	6	7
2	3	4	5	6	7	8	9	10	11	12	13	14
9	10	11	12	13	14	15	16	17	18	19	20	21
16	17	18	19	20	21	22	23	24	25	26	27	28
23	24	25	26	27	28	29	30	31				
30	31											

16	16 *	15	14	13	12	12 *	11	10	9	8	8 *	7	7 = 1907
22	21	20	20 *	19	18	17	16	16 *	15	14	13	12	8 = 1908 etc.

The figures are self-explanatory. To use the calendar, slide the top card over the bottom card until the name of the month and the number of the year desired are opposite each other. The calendar for that month will then appear

through the section cut from the top card. The details of construction and the reasons for the arrangements need not be given here, but will be furnished if requested. The period of years may be extended at will. The size and shape may also be varied to suit individual tastes.

RELATING TO SOLUTIONS OF QUADRATIC EQUATIONS.

By Geo. R. Dean, Missouri School of Mines.

I. *Solution of the Quadratic without factoring or completing the square.*

Let the equation be

$$ax^2 + bx + c = 0.$$

Put

$$x = u + iv, \qquad \text{where} \qquad i = \sqrt{-1}.$$

Then

$$a(u^2 - v^2 + 2uvi) + b(u + iv) + c = 0,$$

$$a(u^2 - v^2) + bu + c + i(2auv + bv) = 0,$$

Since the real and imaginary parts vanish separately,

$$a(u^2 - v^2) + bu + c = 0, \qquad \text{and} \qquad (2au + b)v = 0.$$

And since v is not, in general, equal to zero, we get

$$u = -\frac{b}{2a},$$

from which

$$au^2 + bu + c = c - \frac{b^2}{4a}.$$

Hence,

$$av^2 = c - \frac{b^2}{4a}, \qquad v = \frac{\pm\sqrt{4ac - b^2}}{2a};$$

$$u + iv = \frac{-b \pm i\sqrt{4ac - b^2}}{2a} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

When v, that is, $\dfrac{\sqrt{4ac - b^2}}{2a}$ is imaginary the equation has real roots; and when $v = 0$, equal roots.

There is probably nothing new about this solution, but it affords a good example of the part played by the imaginary unit in higher mathematics, and would not be out of place in our elementary text-books on algebra.

II. *Solution of a Pair of Simultaneous Equations which occurs in the Theory of Cables and Transmission Lines.*

In the following equations the unknown quantities are α and β:

$$\alpha^2 - \beta^2 = RS - LCp^2 \quad (1); \qquad 2\alpha\beta = (RC + LS)p. \quad (2)$$